U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE
HEARING ON
Research on Environmental and Safety Implications of Nanotechnology: What are the Federal Agencies Doing?
September 21, 2006

Questions for the Record Submitted to Dr. Arden Bement

Questions for the Record Submitted by Chairman Sherwood Boehlert

1. In his testimony at the hearing on September 21, Dr. Andrew Maynard from the Wilson Center recommended that the government should ask the Board on Environmental Studies and Toxicology of the National Academies of Science to help develop a long- term research agenda and conduct rolling reviews for nanotechnology environmental and safety research. Dr. Maynard also recommended that the government should contract with the Health Effects Institute to manage and/or perform some of the highest priority research. What is your view of Dr. Maynard's recommendations?

Reply: The National Research Council (NRC) completed its report on the National Nanotechnology Initiative (NNI) with a special section on Environmental, Health and Safety (EHS) in October 2006. The report was requested by Congress and was sponsored by NNI participating agencies. The report evaluated the status of EHS research and provides general guidance for future work. A subsequent NRC study will begin in 2007, and EHS issues will be addressed. The NRC will conduct rolling reviews for nanotechnology, including EHS. The NRC panel may be asked to address additional issues, and include the Board on Environmental Studies and Toxicity in the evaluation. However, another parallel study would be duplicative.

Regarding the issue of management and performance of highest priority research, the mission-oriented agencies are best equipped to address various aspects of the EHS issues. The problems are too complex and diverse to be addressed by a single group in a single institute. A coordinated approach among existing Federal agencies is appropriate. A single institute may not have the expertise in all areas, and may not be able to respond effectively in a fast evolving field. In addition, we believe that basic research funding should be accomplished through a competitive, merit-based process.

2. Does the National Science Foundation (NSF) issue targeted solicitations for research focused on specific potential environmental or safety risks associated with nanotechnology? If not, please explain how NSF addresses the highest priorities in nanotechnology environmental and safety research? Are there are additional ways to target NSF's solicitations to specific risk-based questions, while still preserving the strengths of NSF's investigator-driven model of research?

Reply: The annual NSF program solicitation "Nanoscale Science and Engineering" in the interval FY 2001-2005 included one theme related to nanoscale processes in the environment and another theme on societal implications. The NSF program solicitation "Active Nanodevices and Nanosystems" in FY 2006-2007 has a major theme on societal dimensions of nanotechnology. In the last two years (FYs 2006-2007) NSF has partnered with the Environmental Protection Agency (EPA), National Institute for Occupational Safety and Health (NIOSH) and the National Institute of Environmental Health Sciences (NIEHS) for a separate program solicitation on toxicity. All themes are aligned with the NSF mission of creating fundamental knowledge, establishing the infrastructure including human resources, and supporting nanotechnology education. NSF plans to continue to emphasize the EHS and Ethical, Legal, and Societal Implications (ELSI) areas. We will include environmental aspects in program descriptions, and support workshops to stimulate proposals in the field.

NSF co-sponsored the first (2000) and second (2003) workshops on Societal Implications of Nanoscience and Nanotechnology in order to highlight the key research topics. NSF co-sponsored with EPA and the Nanoscale Science, Engineering, and Technology (NSET) Subcommittee the grand challenge workshop on the environment; the report on those proceedings is expected to be published in November 2006. Also, NSF organized other topical workshops on the environment to identify the research trends and stimulate interest in the community.

3. How has NSF decided how much money to allocate to nanotechnology environmental and safety research? Why is the funding level proposed in NSF's fiscal year 2007 budget request so low compared to what is recommended by the Wilson Center and by Lux Research?

Reply: NSF identifies key knowledge gaps and the level of funding needed to address the issues through the process described in the following paragraph. Because of NSF's critical impact on building a fundamental body of knowledge, specialized facilities and qualified people, NSF funds a large fraction of the overall NNI investment in Societal Dimensions: $59 million (72 percent) of the $82.1 million total in the FY 2007 Request, and $51.5 million (72 percent) of $71.7 million in the FY 2006 estimation (see *The NNI – Supplement FY 2007 Budget*, page 36-37). Of the total NSF contribution to NNI ($373 million), about 16% is for societal dimensions of which 7% is specifically for EHS. These percentages are in the range of those recommended on average for all of NNI by the Woodrow Wilson Center (WWC) and Lux Research (about 4% for EHS recommended by WWC and about 9% recommended by Lux Research on average for all agencies).

The NSF funding level is established following an annual evaluation process where input is sought from the research community, industry, and other organizations. All NSF proposals

under NNI are evaluated by merit review. Also, NSF has an annual process of establishing overall priorities for nanoscale science and engineering research, including:

(a) NSET Subcommittee: Results from periodic workshops and meetings with the communities are synthesized by program directors and discussed in the NSET Subcommittee and its working groups;
(b) National context: NSF contributes to and coordinates its NNI research and education activities through the Nanoscale Science, Engineering and Technology Subcommittee (NSET) of the National Science and Technology Council (NSTC), as a cross-cutting priority reported to the Office of Management and Budget (OMB), and a national priority of the Administration. NSF participates in all NNI workshops, research directions and planning meetings and is coordinating its program with the work done by other agencies in the general context of R&D, infrastructure and education needs;
(c) International context: NSF organized the first "International Dialogue on Responsible Nanotechnology" conference which included 25 countries and the European Union (EU) and was held in the U.S. in June 2004, and contributed to the second in July 2006 in Japan. Other international interactions have been developed with the Organization for Economic Cooperation and Development (OECD), international standards and other international organizations. NSF organized bilateral meetings with the European Commission, Japan, Korea, Switzerland, India, China, Ireland, and others in order to identify research directions and develop collaborations. NSF has recently funded an international project on identifying EHS research needs, and has interactions with the EU and Japan on future joint research funding activities in societal dimensions;
(d) Industry perspective: A joint NNI-industry working group on EHS with the electronic and chemical industries has resulted in a report on EHS Research Needs (2005) and periodically provides input to NSF staff;
(e) Public and Non-Governmental Organizations (NGOs): NSF receives feedback through surveys and periodical interactions. For example, NSF has supported surveys that are used as a reference in setting up the new Network for Nanotechnology in Society. All Nanoscale Science and Engineering Centers (NSEC) and nanotechnology networks supported by NSF are encouraged to have public outreach activities, and two networks have a well-defined task in this area, the Network for Nanotechnology in Society and the Network for Informal Science Education;
(f) Annual Grantees Meetings and other evaluation activities: NSF's Committees Of Visitors (COVs), NSF's Directorate Advisory Committees, OMB's Program Assessment Rating Tool (PART), Presidential Council of Advisors for Science and Technology (PCAST) review);
(g) Interagency Coordination via NSTC/NSET and its three working groups: Nanomaterials Environmental and Health Issues (NEHI), Nanotechnology Innovation and Liaison to Industry (NILI), Global Issues in Nanotechnology (GNI), and Nanotechnology Public Engagement Group (NPEG).

4. In your testimony on September 21, you laid out some specific priorities for nanotechnology environmental and safety research. To what extent do these priorities overlap with the research that other federal agencies are sponsoring? To what extent do these priorities fill research gaps identified in the Wilson Center report? Of the research priorities that the Wilson Center identified, are there some priorities that NSF does not plan to investigate?

Reply: There is very little, if any, overlap**.** The topics covered by NSF align with the agency's mission and cover some of the top recommendations made by both WWC and Lux Research for fundamental understanding, infrastructure, and education in the field of nanotechnology. The mission-oriented goals for testing the toxicity of specific nanomaterials and exposure to the digestive system are best covered by the respective mission oriented agencies.

5. Please explain the degree to which, and how, NSF's agenda for nanotechnology environmental and safety research is shaped by interagency coordination, and how it is shaped by the need to inform potential regulation.

Reply: NSF coordinates closely with other agencies in planning to eliminate duplication of effort and ensure effective knowledge transfer. NSF's agenda in this area is defined by the fundamental knowledge gaps, infrastructure and education needs.

NSF develops its strategic and annual planning, and its collaboration with other participating agencies in NSET and NSET's Nanomaterials Environmental and Health Issues (NEHI) Working Group. NSF conducts fundamental research in EHS according to its mission, which complements the more practical approach of EPA, toxicity studies by the National Institutes of Health (NIH), and regulatory activities by the Food and Drug Administration (FDA) and NIOSH. This research provides a broad-based foundation of knowledge, trained people and suitable laboratory infrastructure for the mission-specific applied R&D done by the regulatory agencies. NSF-sponsored research and education results have long-term, broad impact and may be used by multiple agencies. All NSF awards are listed on the website and searchable by programs, authors, and keywords. In addition, NSF has communicated its results at periodic interagency meetings and workshops, including grantees workshops.

Questions for the Record Submitted by Ranking Minority Member Bart Gordon

1. NSF funds well over half of all EHS research under the NNI. How specific are NSF's announcements to the research community regarding funding opportunities in this area? That is, does NSF direct the attention of potential grant awardees to research questions of high relevance to the regulatory agencies responsible for dealing with the human health and environmental risks of nanomaterials, and what percentage of the EHS funding available from NSF would fall into this category of directed basic research?

Reply: NSF has allocated a high percentage of its investment in nanotechnology in the EHS area in order to define the key science and engineering issues, prepare the scientific foundation for environmental implications, develop the research infrastructure and train suitable workers in the field. NSF conducts fundamental research in EHS according to its mission, which complements the more practical approach of EPA, toxicity studies by NIH, and regulatory activities by FDA and NIOSH. NSF has encouraged research in the fundamental aspects of EHS partially by its program solicitations and several core program descriptions, as well as workshops and conferences on these topics.

2. In his testimony at the hearing, Dr. Maynard suggested a mechanism for government to partner with industry to fund EHS research that would support the needs of government in formulating a regulatory framework for nanomaterials and the needs of industry on how to develop nanotechnology safely. The idea is to use the Health Effects Institute model, which studies the health effects of air pollution. What are your views on this suggestion: would this be a workable approach for instituting a government/industry partnership for support of EHS research related to nanotechnology?

Reply: We believe that fundamental research on nanotechnology EHS issues will be advanced most effectively by supporting researchers at academic institutions using merit review. The role of government is in creating the knowledge foundation for industry to apply knowledge, general principles and reference data to various applications. It is not clear that placing all resources in one place for a complex problem with multiple stakeholders (government, various industries with proprietary claims, public, NGOs) would lead to superior results.

3. In responses to questions at the hearing, the agency witnesses seemed to be saying the current planning/coordinating mechanism for EHS research based on the NEHI working group will be able to produce an EHS research plan or roadmap, consisting of a cross-agency set of specific research priorities, timelines, and associated funding targets broken out by agency. What adjustments are needed to the way NEHI functions or to the way it is staffed to achieve this goal in a timely way?

Reply: NEHI is a working group that provides coordination in the field of EHS and reports to NSET. NEHI plays an advisory role to agencies. The Office of Science and Technology Policy (OSTP) and OMB coordinate the research and development plans, set priorities with input from agencies, and approve budgets for NNI each year, including for EHS efforts. Accordingly, only agencies with financial responsibility and under guidance from OMB and OSTP can set priorities and allocate funding. No changes are needed in the NEHI function and staffing.